AC NO: 43-14
DATE: 2/24/77

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: MAINTENANCE OF WEATHER RADAR RADOMES

1. PURPOSE. This advisory circular provides guidance material useful to repair facilities in the maintenance of weather radar radomes.

2. CANCELLATION. AC 43-202, dated 6/11/65, and AC 90-20, dated 11/12/64, are cancelled.

3. GENERAL. A radome is a covering whose primary purpose is to protect a radar antenna from the elements. It is a part of the airframe and, therefore, should have certain physical as well as electrical properties, Physically, a radome should be, strong enough to withstand the airloads that it will encounter and it should be contoured to minimize drag. These properties vary with the shape, design speed, and size of the airplane on which it is to be installed. Electrically, a radome should permit the passage of the radar's transmitted signals and return echoes with minimum distortion and absorption. In order to do this, it should have a certain electrical thickness. The electrical thickness of a radome is related to the physical thickness, operating frequency, and the types of material and construction used. This relationship is defined by a number of complex mathematical equations which are of interest only to radome design engineers. These equations show that, for given physical properties, a radome should have a certain electrical thickness for a certain narrow range of operating frequencies. (This is the reason why C-band radomes will not give optimum performance with X-band radars and vice versa.) Also, a very small variation in physical thickness may cause a sizable variation in electrical thickness. Radar efficiency, definition, and accuracy of display depend upon a clear, nondistorted, reflection-free antenna view through the radome. Consequently, a radome should be precisely built for optimum performance.

4. RADOME CHARACTERISTICS. There are two general types of radomes, the "thin wall" and "sandwich" types. Thin wall radomes are considered to be thin relative to the wavelength of the radar. They are generally useful when the radar frequency is low enough to permit a skin thickness which will satisfy the structural requirements. Sandwich radomes consist of two

or more plastic skins separated by a dielectric core, The core may consist of honeycomb plastic sections, hollow flutes, or foam plastic. The dielectric and separation of the skins will depend upon the wavelength of the radar frequency or frequencies,

5. RADOMEDAMAGE. Probably the most frequent damage to radomes is holes in the structure caused by static discharges. These can be large holes that are readily apparent, or small pin holes that are almost imperceptible. Any hole, regardless of size, can cause major damage to a radome since moisture can enter the radome wall and cause internal delamination. If the moisture freezes, more serious damage may occur. If enough moisture collects, the radiation pattern will be distorted and the transmitted signals and return echoes seriously attenuated. Ram air through a hole can delaminate and break the inner surface of the radome and result in separation of the skins or faces' of the material from the core, weakening the radome s truc ture. Other types of damage are characterized as dents and scratches caused by impact with stones and birds and improper handling of the radome when it is removed for maintenance of the radar antenna. This type of damage is easily found by inspection.

6. MAINTENANCE.

a. High performance radar radomes are very precisely constructed and sometimes the slightest change in their physical characteristics, such as excessive layers of paint, can adversely affect radar system performance. All repairs to radomes, no matter how minor, should return the radome to its original or properly altered condition, both electrically and structurally. The performance of proper maintenance to precision radomes requires special knowledge and techniques and the use of proper tools and materials. An improper minor repair can eventually lead to an expensive major repair. A radome having undergone major repairs should be tested to ascertain that its electrical properties have not been impaired. The testing of radomes requires test equipment that usually is found only in repair facilities specializing in radome maintenance. Even minor repairs may affect one or all of the following:

(1) Transmissivity. Which is the ability of a radome to pass radar energy through it.

(2) Reflection. Which. is the return or reflection of the outgoing radar energy from the radome back into the antenna and waveguide system.

(3) Diffraction. Which is the bending of the radar energy as it passes through the radome.

b. These electrical properties, when altered by improper repair, may cause loss of signal, distortion and displacement of targets, and can clutter the display to obscure the target. Poor radome

electrical performance can produce numerous problems which may appear to be symptoms of deficiencies in other units of the radar system. The following are examples of improper repair:

(1) Use of wrong materials - not compatible with original radome materials.

(2) Patches of different thickness.

(3) Poor fabrication techniques.

(4) Nonvoid-free patches.

(5) Repairs overlapping.

(6) Holes plugged with resin, screws, metal, wood, and plastic plugs.

(7) Cuts or cracks simply coated with resin.

(8) Tape (including electrical tape) over hole or crack and covered with resin.

(9) Oversize patches.

(10) Too much or too little resin.

(11) Exterior coatings - too many coats, too thick, uneven thickness - metallic base paints.

(12) Filled honeycomb cells.

(13) Repairs made without removing moisture or moisture contamination from inside of radome wall.

(14) Abrupt changes in cross-sectional areas.

(15) Patches projecting above outside contour lines.

(16) Improper cure.

(17) Wrong size cells or density of honeycomb.

(18) Excessive overlap in honeycomb joints.

(19) Poor bonding of skin to core.

(20) Gaps in honeycomb core.

7. RECOMMENDATION. Both the physical and electrical properties of radomes should be given careful consideration during repair operations. These properties are carefully controlled during manufacture and should not be altered by improper repairs.

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